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April 23, 2003

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From: Brian M. Dugan

Our File No.: 3130/D1/DSM/PMD/JW

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	Chen-An Chen and Won Bang
Serial No.	:	09/902,283
Filed	:	July 10, 2001
For	:	CLOG RESISTANT INJECTION VALVE
Examiner	:	Sylvia R. MacArthur
Group Art Unit	:	1763

TOTAL NUMBER OF PAGES INCLUDING THIS PAGE: 13

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Examiner MacArthur:

Attached are copies of the Response to Office Action as filed and the PTO stamped return postcard. Please note that the response was inadvertently filed under the serial no. of the parent case (09/248,789).

Best regards,
Brian Dugan

Box: NON-FEE AMENDMENT
Assistant Commissioner for Patents
Washington, D.C. 20231
Applicant(s): Chen-An Chen and Won Bang
Assignee: Applied Materials, Inc.
Title: CLOG RESISTANT INJECTION VALVE
Serial No. 09/248,789 Filed 07/10/01
Attorney Docket No.: 3130/D1/DSM/PMD/JW

Enclosed:
X Response to Office Action
X PTO Transmittal (in duplicate)
X Return Receipt postcards

Dated: February 6, 2003
Express Mail Label No. EV260646865US

3130/D1/DSM/PMD/JW Express Mail Label No. EV260646865US

PATENTS

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Hon. Assistant Commissioner
for Patents
Washington, D.C. 20231

RESPONSE TO OFFICE ACTION

Sir:

In response to the Office Action dated November 6, 2002, Applicants appreciate the Examiner's review of the present application and respectfully request reconsideration of the same in light of the following remarks.

The Examiner has rejected claims 1-3, 5, 6, 9-13 and 19 under 35 USC § 102 as being anticipated by Takamatsu et al. (U.S. Patent No. 6,155,540)

Independent claim 1 requires:

> 1. A method of vaporizing a processing liquid, comprising:
> providing an injection valve having:
> a vaporization region;
> a processing liquid inlet coupled to the vaporization region;
> a carrier gas inlet coupled to the vaporization region;

an outlet coupled to the vaporization region and adapted to outlet a mixture of carrier gas and vaporized processing liquid; and

a wave generator operatively coupled to the vaporization region so as to vibrate the vaporization region;

flowing processing liquid into the vaporization region of the injection valve; and

vibrating the vaporization region.

Independent claim 9 requires:

9. A method of vaporizing a processing liquid, comprising:

flowing processing liquid into a vaporization region of an injection valve; and

simultaneously vibrating the vaporization region.

Independent claim 17 (from which claim 19 depends) requires:

17. A method of vaporizing a processing liquid, comprising:

providing an injection valve having:

a plate that defines a vaporization region;

a piezoelectric coupled to the plate;

a processing liquid inlet coupled to the vaporization region;

a carrier gas inlet coupled to the vaporization region;

an outlet coupled to the vaporization region and adapted to output a mixture of carrier gas and vaporized processing liquid; and

a wave generator coupled to the piezoelectric wherein the wave generator is adjustable so as to open the processing liquid inlet, close the processing liquid

inlet and vibrate the vaporization region via a voltage signal output to the piezoelectric;

flowing processing liquid into the vaporization region of the injection valve; and

vibrating the vaporization region.

As described below, Takamatsu et al. does not disclose the methods of independent claims 1, 9 or 17.

Takamatsu et al. discloses an apparatus for vaporizing a liquid CVD material within a carrier gas, and is adapted to supply the CVD material in a manner that enables easy control of the concentration of the CVD material in the vaporization such that quick changes may be made to that concentration (col. 2 lines 2-32).

The apparatus of Takamatsu comprises, in relevant part: at least one inlet 5 (col. 6 line 11) for introducing a liquid material 2 (col. 6 line 26), at least one inlet 17 (col. 6 lines 17-18) for introducing of pre-heated (col. 6 lines 44-45) carrier gas, an ultrasonic atomizing device 15 (col. 6 lines 13-14) for atomizing the liquid material 2, a vaporizer 9 (col. 5 line 65) enclosed within a block heater 11 (col. 6 line 3) for instantly heating and vaporizing (col. 6 line 45-46) the atomized liquid material 2 by bringing the atomized liquid material 2 in contact with a circular flow of the pre-heated carrier gas (col. 6 line 30-31), and an outlet (col. 2 line 50) for the vaporized gas to exit the vaporizer 9.

The ultrasonic atomizing device 15 comprises an ultrasonic vibrator 14 (col. 6 line 15) for atomizing (col. 6 lines 28-29, 41-42) the liquid material 2. All

embodiments of the vaporizer 9 provide that the vaporizer 9 comprises an end part (col. 2 line 52-53) through which passes the inlet 17 for introducing pre-heated carrier gas.

A first embodiment of the apparatus of Takamatsu (FIG. 2) provides that an elongated ultrasonic atomizing device 15, having an ultrasonic vibrator 14 at a end thereof, penetrates the vaporizer 9 so that the ultrasonic vibrator 14 is disposed at a central part of (i.e., within the) vaporizer 9, and that inlets 5 penetrate an upper part of the vaporizer 9 so as to introduce the liquid material 2 such that the liquid material 2 flows directly into the ultrasonic vibrator 14 for immediate atomization and subsequent vaporization within the vaporizer 9. A second embodiment of the apparatus of Takamatsu (FIG. 3) provides that the ultrasonic atomizing device 15 comprises a separate enclosure disposed outside of the vaporizer 9 and containing the ultrasonic vibrator 14, an inlet 5 penetrates the enclosure of the ultrasonic atomizing device 15 so as to introduce the liquid material 2 such that the liquid material 2 flows directly into the ultrasonic vibrator 14 for immediate atomization within the enclosure of the ultrasonic atomizing device, and the atomized liquid material 2 is thereafter introduced into the vaporizer 9 for subsequent vaporization within the vaporizer 9.

A relevant method of use of the apparatus of Takamatsu comprises: 1) introducing the liquid material 2 via an inlet 5, either directly into a vaporizer 9 containing an ultrasonic atomizing device 15 (FIG. 2, col. 6 lines 26-27), or into an ultrasonic atomizing device 15 that is outside the vaporizer 9 (FIG. 3, col. 6 lines 41-42); 2) atomizing the liquid material 2 (col. 6 lines 28-29) by directing the flow of liquid material 2 from the inlet 5

toward an activated ultrasonic vibrator 14 disposed at the inlet 5 (col. 6 lines 29, 42-43); and 3) heating and vaporizing (col. 6 lines 31-32, 45-56) the atomized liquid material 2 by subjecting the atomized liquid material 2 to heat from a heating block 11 (col. 6 lines 3-6) and bringing it into contact within a circular flow of preheated carrier gas (col. 6 lines 30-31, 43-44) within the vaporizer 9 (col. 6 lines 26-27, 42-43).

As is evident from the foregoing, Takamatsu nowhere provides a method of vaporizing a liquid material that involves either the use of, or the provision and use of, an injection valve comprising a vaporization region, as required by pending independent claims 1, 9 and 17. Specifically, the vaporization region of Takamatsu is part of the vaporizer 9, and the vaporizer 9 is not an injection valve.

In addition, in Takematsu, the ultrasonic vibrator 14 mounted adjacent to or within the vaporizer 9 is described therein only as having the function of atomizing the liquid material 2, and no method described within Takematsu calls for any other use for the ultrasonic vibrator 14. For example, vibrating the vaporization region of the injection valve, as called for in claims 1, 9 and 17, is not disclosed or suggested by Takematsu. In addition, providing a wave generator so as to vibrate the vaporization region of the injection valve, as further called for in claims 1 and 17, is also not disclosed or suggested by Takematsu.

Claim 17 still further calls for 1) providing a plate that defines a vaporization region, 2) providing a piezoelectric coupled to the plate, and 3) providing a wave generator coupled to the piezoelectric wherein the wave

generator is adjustable so as to open the processing liquid inlet, close the processing liquid inlet and vibrate the vaporization region via a voltage signal output to the piezoelectric. No such method steps are disclosed or suggested by Takematsu.

Specifically, in accordance the present invention, the wave generator is coupled to an injection valve's vaporization region so as to vibrate the vaporization region (pg. 3 lines 7-12 of present application), which may dislodge "residue from the vaporization region, the carrier gas inlet, the processing liquid inlet and the outlet, and/or prevents residue from lodging therein." (Page 3, lines 16-19 of present application).

Accordingly, Takamatsu et al. fails to disclose "vibrating the vaporization region," as required by claims 1, 9 and 17. As well, Takamatsu et al. fails to disclose providing an "injection valve," as required by claims 1 and 17. Moreover, Takematsu et al. fails to disclose either providing a "wave generator operatively coupled to the vaporization region so as to vibrate the vaporization region," as required by claim 1, or providing a "wave generator coupled to the piezoelectric wherein the wave generator is adjustable so as to open the processing liquid inlet, close the processing liquid inlet and vibrate the vaporization region via a voltage signal output to the piezoelectric," as required by claim 17. Also, Takamatsu et al. fails to disclose providing a "plate," and providing a "piezoelectric," also as required by claim 17.

In light of the foregoing, Applicants respectfully submit that independent claim 1 and dependent claims 2-3 and 5-6 which depend therefrom, independent claim 9 and dependent claims 10-13 which depend therefrom, and

independent claim 17 and dependent claim 19 which depends therefrom, are not anticipated by Takematsu et al.

The Examiner has rejected claims 4,16-17, and 20-21 under 35 USC 103 (a) as being unpatentable over Takamatsu et al. in view of Micard (U.S. Patent No. 4,684,104).

Independent claim 16 requires:

> 16. A method of vaporizing a processing liquid, comprising:
> providing an injection valve having:
> a vaporization region;
> a processing liquid inlet coupled to the vaporization region;
> a flexible plate that defines a vaporization region and which is used to close the processing liquid inlet;
> a piezoelectric coupled to the flexible plate;
> a carrier gas inlet coupled to the vaporization region;
> an outlet coupled to the vaporization region for outletting a mixture of carrier gas and vaporized processing liquid; and
> a wave generator coupled to the piezoelectric wherein the wave generator is adjustable so as to open the processing liquid inlet, close the processing liquid inlet and vibrate the vaporization region via a voltage signal output to the piezoelectric;
> flowing processing liquid into the vaporization region of the injection valve; and
> vibrating the vaporization region.

As stated above, Takamatsu et al. does not disclose the methods of independent claims 1, 9 or 17. It

shall also be evident, based on the above recitation of independent claim 16 and the above remarks (especially those remarks relating to independent claim 17, which comprises many of the same limitations as does independent claim 16), that Takematsu et al. also fails to disclose the methods of independent claim 16.

For example, the step of vibrating the vaporization region of the injection valve, common to all of the above claims, is nowhere disclosed, taught, or suggested by Takamatsu et al. or Micard.

The Examiner has cited Micard for its disclosure of an electrically controlled valve having a piezoelectric element comprising a stack of piezoelectric ceramics. However, neither Takamatsu et al. nor Micard disclose, teach or suggest the method of claim 4, which depends from independent claim 1, the methods of independent claims 16 and 17 (set forth above), the method of claim 20, which depends from independent claim 17, or the method of claim 21, which depends from dependent claim 20.

Also, as shown in FIGS. 2-3 of Takamatsu et al., it would not be practical for the vaporization region formed by the vaporizer 9 to simultaneously comprise a portion of an injection valve, or for the vaporizer 9 to be converted to an injection valve. The vaporizer 9 of Takamatsu comprises a rounded end within which the preheated carrier gas is circulated, and as such is specifically designed for heating and vaporization of the atomized liquid material 2. In addition to being likely to significantly interfere with the heating and vaporization function of Takamatsu, the flat ceramic plates of the piezoelectric of Micard would be incompatible with the rounded end shape of the embodiment of the vaporizer illustrated in FIG. 3 of Takamatsu, and as

such would be incapable of functioning to seal the flow of liquid material 2 into the vaporizer. In addition, the ceramic plates of the piezoelectric of Micard would most likely tend to damage the inlets 5 of the embodiment of the vaporizer illustrated in FIG. 2 of Takamatsu, leading to the same result.

In light of the foregoing, Applicants respectfully submit that dependent claim 4, independent claims 16 and 17, and dependent claims 20-21 are in condition for allowance.

The Examiner has rejected claims 7 and 10 under 35 USC 103 (a) as being unpatentable over Takamatsu et al. in view of Nguyen et al. (U.S. Patent No. 5,925,189).

As stated above, Takamatsu et al. does not disclose the methods of independent claims 1 or 9. The Examiner has cited Nguyen et al. for its disclosure of a liquid precursor delivery apparatus. However, neither Takamasu et al. nor Nguyen et al. disclose, teach or suggest the method of claim 7, which depends from independent claim 1, or the method of claim 10, which depends from independent claim 9. For example, the step of vibrating the vaporization region of the injection valve, common to all of the above claims, is nowhere disclosed, taught, or suggested by Takamatsu et al. or Nguyen et al. In light of the foregoing, Applicants respectfully submit that dependent claims 7 and 10 are in condition for allowance.

The Examiner has rejected claims 8 and 15 under 35 USC 103 (a) as being unpatentable over Takamatsu et al. in view of Nguyen et al., in further view of Ketchum (U.S. Patent No. 5,413,671).

As stated above, Takamatsu et al. does not disclose the methods of independent claims 1 or 9. The

Examiner has cited Nguyen et al. for its disclosure of a liquid precursor delivery apparatus, and Ketchum for its disclosure of a process for cleaning a process chamber. However, none of Takamatsu et al., Nguyen et al. and Ketchum disclose, teach or suggest the methods of independent claim 8, which incorporates all of the limitations of claim 1 (as well as the limitations of claim 6), or independent claim 15, which incorporates all the limitations of independent claim 9 (as well as the limitations of claim 13). For example, the step of vibrating the vaporization region of the injection valve, common to all of the above claims, is nowhere disclosed, taught, or suggested by Takamatsu et al., Nguyen et al., or Ketchum. In light of the foregoing arguments, Applicants respectfully submit that independent claims 8 and 15 are in condition for allowance.

In light of the foregoing remarks, Applicants respectfully request reconsideration and allowance of the pending claims.

Applicants do not believe any additional fees are due regarding this amendment. If any additional fees are required, however, please charge Deposit Account No. 04-1696.

3130/D1/DSM/PMD/JW Express Mail Label No. EV260646865US

Applicants encourage the Examiner to telephone Applicants' attorney to discuss the amendment should any issues remain.

Respectfully submitted,

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Dated: February 6, 2003
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